

AK2

SN: 10/532, 545

## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-200888

(43)Date of publication of application : 27.07.1999

(51)Int.Cl.

F02C 6/00

F01K 27/02

F02C 7/00

F02K 3/06

H01M 8/06

(21)Application number : 10-007446

(71)Applicant : MITSUBISHI HEAVY IND LTD

(22)Date of filing : 19.01.1998

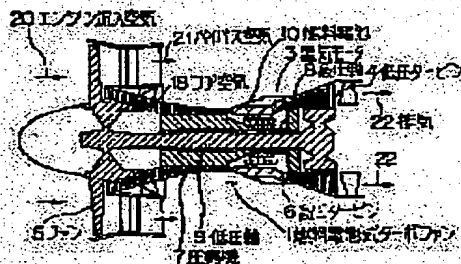
(72)Inventor : KISHI KIMIHIRO

## (54) FUEL CELL TYPE TURBINE ENGINE

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To largely improve energy efficiency by providing a fuel cell to generate electric power by electrochemical reaction of hydrogen or carbon monoxide and oxygen, driving a turbine by a motor by using this fuel cell as a power source, and supplying steam generated at power generation time of the fuel cell to the turbine.

**SOLUTION:** A fuel cell 10 generates electric power by electrochemical reaction of hydrogen in fossil fuel 19 and oxygen in compressed air 17 by supplying the fossil fuel 19 and the compressed air 17 by compressing core air 18 by a compressor 7 to this, but high temperature/high pressure steam of 600°C to 1000°C is generated in a fuel side electrode 14 at this time. A fan 5 and the compressor 7 are respectively actuated by driving an electric motor 3 by electricity generated there. The compressor 7 arranged in a coaxial shape with a high pressure turbine 6 is driven together with the electric motor 3 by driving the high pressure turbine 6 in rotation by steam generated by the fuel side electrode 14. A low pressure steam turbine 4 is driven by steam coming out of the high pressure turbine 6.



**\* NOTICES \***

JPO and INPIT are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

**DETAILED DESCRIPTION**

---

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention The turbo-fan engine for airplanes, a propeller turbine, The industrial turbine engine which performs a turboshaft engine, an auxiliary power unit, machinery drive, or power generation, Or it is related with the fuel cell type turbine engine it was made to drive a turbine engine for ships with the fuel cell which was made to perform power generation according to the electrochemical reaction of hydrogen or carbon monoxide, and oxygen.

[0002]

[Description of the Prior Art]Drawing 12 is a sectional view showing the conventional aviation gas turbine type turbo-fan engine. As shown in a figure, the conventional gas turbine type turbo-fan engine (only henceforth a turbo-fan engine) 86, After fossil fuels', such as gasoline's injected in the burner 87, burning, introducing it into the low pressure turbine 92 after the combustion gas which became an elevated temperature and high voltage makes the high pressure turbine 88 rotate, and making the low pressure turbine 92 drive, it is emitted to the open air as the exhaust gas 91, and he is trying to generate impelling force.

[0003]The energy of the combustion gas absorbed by the high pressure turbine 88, i.e., driving force, rotates the compressor 89 formed the high pressure turbine 88 and in the shape of the same axle, it compresses the core air 90 which flows into the turbo-fan engine 86, and is sent into the combustion chamber 87 as an oxidizer which burns a fossil fuel. On the other hand in the rear end part of an inner roll it is inserted in and made to rotate independently of the axis of rotation, the inside of the axis of rotation which formed the compressor 89 and the high pressure turbine 88. While the low pressure turbine 92 which combustion gas after driving the high pressure turbine 88 is introduced, and operates is formed and generating a thrust, the driving force of the low pressure turbine 92, While being provided in the front end part of the

turbo-fan engine 86 via an inner roll and generating a thrust, the fan 93 which supplies core air to the compressor 89 is operated.

[0004]Drawing 13 is a sectional view showing the conventional aviation gas turbine type propeller turbine (henceforth a propeller turbine) 94. Also in the propeller turbine 94, after the combustion gas which was made the same composition as the burner 87 of the turbo-fan engine 86 and which burned with the burner 95 makes the turbine 96 rotate and generates a thrust, it is emitted to the open air as the exhaust gas 110. The driving force absorbed in the turbine 96 rotates the turbine 96 and the compressor 97 formed in the shape of the same axle, and compresses the core air 98 which flows in the propeller turbine 94.

[0005]The propeller 99 is rotated via the gear device which the axis of rotation of the compressor 97 and the shape of the same axle was established ahead of the compressor 97, and was formed at the tip of the axis of rotation on the other hand, and while generating a thrust, he is trying to make the core air 98 flow in the compressor 97 in the propeller turbine 94.

[0006]Drawing 14 is a sectional view showing the conventional gas turbine type turboshaft engine 100 for helicopters (henceforth a turboshaft engine). Also in the turboshaft engine 100, the combustion gas which burned with the burners 87 and 95 shown in drawing 12 and drawing 13, and the burner 101 made the same composition, after making the turbine 102 and the free power turbine 103 provided in the slipstream side of the turbine 102 rotate, it is emitted to the open air as the exhaust gas 104.

[0007]The driving force absorbed in the turbine 102 rotates the turbine 102 and the compressor 105 formed in the same axle, and compresses the core air 106 which flows into the turboshaft engine 100. The driving force absorbed by the free power turbine 103 which operates with combustion gas after driving the turbine 102 on the other hand, The output shaft 106 is rotated, the axis of rotation 108 connected with the output shaft 106 by the bevel gear is rotated, the rotor 107 connected with the upper bed of the axis of rotation 108 is rotated, and buoyancy and impelling force are generated.

[0008]However, like the turbo-fan engine 86 mentioned above, the propeller turbine 94, or the turboshaft engine 100, The conventional gas turbine engine supplies a fossil fuel and the compressed air from the compressors 89 and 97,105 in the burner 87 and 95,101, and it was made to generate driving force with the burned combustion gas by chemical reaction combustion of a fossil fuel. In order to try to generate driving force, there are the following problems.

[0009](1) The emission gas 91,104,110 discharged to the open air has much nitrogen oxides and carbon dioxide, and the operation of these engines causes air pollution.

[0010](2) With about 30 to 40%, the efficiency (henceforth energy efficiency) used as driving force among the energies which fossil fuels, such as gasoline, hold is low, and is not used

effectively.

[0011]The hydrogen contained in hydrogen or a fossil fuel, oxygen, or oxygen in the air in recent years, The fuel cell it enabled it to raise energy efficiency by leaps and bounds as compared with the conventional engine is developed without making it react electrochemically, generating electricity, and abolishing discharge of toxic substances, such as nitrogen oxides accompanying power generation, and carbon dioxide, or lessening, and causing air pollution.

[0012]However, the airplane, marine vessel which contain a rotorcraft for such a fuel cell, While including in the gas-turbine-engine main part which drives vehicles, an industrial machine, or a dynamo, using for generation of the compressed air by the compressor formed in a gas turbine engine and planning improve efficiency, A turbine is driven with the steam generated with power generation of a fuel cell, recovery of steamy energy is also aimed at, and the fuel cell type gas turbine engine it enabled it to raise energy efficiency is not realized further until now.

[0013]

[Problem(s) to be Solved by the Invention]In order that this invention may cancel conventionally the fault which the gas turbine engine currently used as an object for airplanes, etc. mentioned above, While driving a turbo-fan engine, a propeller turbine, or a turboshaft engine for airplanes, etc. with a fuel cell, without discharging the obnoxious waste which causes air pollution, Let it be a technical problem to provide the fuel cell type turbine engine which can raise energy efficiency substantially, as the steam generated at the time of power generation of a fuel cell is also used as driving force and it can make the most by making into driving force energy which fuel holds further.

[0014]

[Means for Solving the Problem]For this reason, a fuel cell type turbine engine of this invention was made into the following means.

[0015](1) A fuel cell which generates electricity according to electrochemical reaction of hydrogen in a fossil fuel or hydrogen, carbon monoxide, and oxygen in the air was formed. It may be made for what have refined high purity besides what is extracted out of a fossil fuel or the air to be used for hydrogen supplied in order to generate electricity according to electrochemical reaction, oxygen, etc.

[0016](2) Electric power generated with a fuel cell was used as a power supply, and a motor which makes a driving shaft generate driving force was formed. It is preferred to make it a thing of structure which uses an output shaft of a motor as a driving shaft, and does not establish a driving force transmission mechanism between a motor and a driving shaft.

[0017](3) A turbine was formed in a driving shaft generated by driving force by a motor.

(4) supplying a turbine which formed a steam generated at the time of power generation of a fuel cell in a driving shaft, and making a turbine generate driving force – driving force of a

motor -- in addition, a steam feeding means it was made to operate a driving shaft also with driving force of a turbine was formed.

[0018]In addition to \*\*\*\* (1) thru/or a means of (4), a fuel cell type turbine engine of this invention was made into the following means.

[0019](5) A motor installed in a fuel cell type turbine engine and a compressor which generates compressed air supplied to an air lateral electrode of a fuel cell to a driving shaft driven in a turbine were formed.

[0020]

[Embodiment of the Invention]Hereafter, one gestalt of operation of the fuel cell of this invention and a fuel cell type turbine engine is explained based on a drawing. Drawing 1 is a sectional view showing the fuel cell type turbo-fan engine (only henceforth a turbo-fan engine) as the 1st gestalt of operation of the fuel cell type turbine engine of this invention.

[0021]As shown in a figure, the turbo-fan engine 1 of this embodiment comprises the fuel cell 10, the electric motor 3, the low pressure turbine 4, the fan 5, the high pressure turbine 6, and the compressor 7. While carrying out the high pressure turbine 6 and the compressor 7 concentrically with the high voltage axis 8 and connecting them, the low pressure turbine 4 and the fan 5 penetrate the hole drilled in the high voltage axis 8 along with the axial center of the high voltage axis 8, and are formed, and the high voltage axis 8 is connected by the low-pressure axis 9 rotated independently.

[0022]The fuel cell 10 generates electricity according to the electrochemical reaction of the position by which the conventional burner 87 grade is arranged, and the fossil fuel supplied by the fuel supply means which has been arranged at the same position and carried out the graphic display abbreviation at the fuel lateral electrode 14 side and oxygen in the air supplied to the abbreviated lateral electrode [ air ] 12 side by the air supply means (compression). The electric motor 3 driven with the electric power generated with this fuel cell 10 is built into the low-pressure axis 9 and the high voltage axis 8, respectively. The fuel cell 10 used for the turbo-fan engine 1 of this embodiment comprises the electrolyte content ceramic pipe 11, the air lateral electrode 12, the porosity ceramic pipe 13, the fuel lateral electrode 14, and the intermediate terminal 15 which have been arranged concentrically, as shown in drawing 2.

[0023]In the turbo-fan engine 1 constituted in this way, While the fossil fuel 19 and the compressed air 17 into which the core air 18 was compressed with the compressor 7 are supplied to the fuel cell 10 and the electrochemical reaction of hydrogen in the fossil fuel 19 and oxygen in the compressed air 17 generates electricity inside, In the fuel lateral electrode 14, the steam of high temperature high pressure (600 \*\* - 1000 \*\*) occurs. The electric motor 3 operates with this generated electrical and electric equipment, the electric motor 3 rotates respectively the low-pressure axis 9 and the high voltage axis 8 which were incorporated, respectively, and the fan 5 and the compressor 7 are operated, respectively.

[0024]There are some which were made to generate electricity depending on the fuel cell 10 according to the electrochemical reaction of hydrogen in the fossil fuel 19 and carbon monoxide, and oxygen in the compressed air 17 so that it may mention later, but. In order to explain simply, in explanation of each embodiment of a fuel cell type turbine engine, the power generation in the fuel cell 10 is explained as what is generated by the electrochemical reaction of hydrogen and oxygen.

[0025]On the other hand, the steam of the high temperature high pressure generated with the fuel lateral electrode 14 makes the high pressure turbine 6 rotate, and drives the compressor 7 ~~formed in the high voltage axis 8 the high pressure turbine 6 and in the shape of the same axle~~ with the electric motor 3. After the steam with which it is discharged from the high pressure turbine 6, and energy remains uses the low pressure turbine 4 as a steam turbine and makes it rotate further, it is emitted to the open air as the exhaust gas 22. Rotation of the low pressure turbine 4 is made into the low pressure turbine 4 and the shape of the same axle with the low-pressure axis 9, The fan 5 arranged at the tip part of the turbo-fan engine 1 is rotated, the engine inflow air 20 is compressed, and the bypass air 21 which makes it blow off back and generates a thrust, and the core air 18 introduced into the compressor 7 mentioned above are generated.

[0026]Next, the compressor 7 as a compressed air supply means rotates by the drive of the high voltage axis 8, The core air 18 is compressed and it explains supplementarily about power generation by the electrochemical reaction of oxygen in the compressed air 17 introduced in the porosity ceramic pipe 13, and hydrogen in the fossil fuel 19 introduced into the circumference of the fuel lateral electrode 14 by the fuel supply means.

[0027]In the fuel lateral electrode 14, hydrogen in the fossil fuel 19 and the oxide ion which was generated by the air lateral electrode 12 and has passed the electrolyte content ceramic pipe 11 react, an electron is generated, and the current 16 which flows into the fuel lateral electrode 14 from the air lateral electrode 12 occurs. That is, in the air lateral electrode 12, the oxygen which has passed the porosity ceramic pipe 13, and the electron which is generated by the fuel lateral electrode 14 and flows into the air lateral electrode 12 are connected, and oxide ion is generated. This oxide ion passes the electrolyte content ceramic pipe 11, moves to the fuel lateral electrode 14, reacts to hydrogen, generates an electron, generates the potential difference from which the air lateral electrode 12 becomes + and the fuel lateral electrode 14 becomes -, and the current 16 which flows into the fuel lateral electrode 14 from the air lateral electrode 12 generates it.

[0028]Since the turbo-fan engine (fuel cell type) 1 of this embodiment is made above-mentioned composition, it has the following technical features.

[0029](1) By using the drive by the fuel cell 10 which generates electricity according to electrochemical reaction from the combustion energy by the chemical reaction of the fossil fuel

19, a combustion stroke is lost, there is no generating of the nitrogen oxides accompanying combustion, and the yield of carbon dioxide can also reduce the drive of the turbine engine 1. [0030](2) what the fuel cell 10 is built into the portion which installs the conventional burner 87 for – a weight saving -- it can miniaturize.

[0031](3) By absorbing and exploiting in a turbine the energy of the steam generated with the fuel cell 10, it can combined-cycle-ize, and as shown in drawing 3, generation efficiency can be raised as compared with power generation using the combustion energy by a chemical reaction.

~~[0032](4) While being able to consider it as low fuel consumption since the turboengine 1 is~~ driven with the electric motor 3, and the turboengine 1 can be operated in rating, as shown in drawing 4, the efficiency by part load can also be raised.

[0033](5) Generation efficiency can be raised by making air to the fuel cell 10 to supply into the compressed air 17 generated with the compressor 7.

[0034](6) This electric motor 3 can be used as an engine starter needed for the turboengine 1.

[0035](7) Further, only by the change of an electric circuit, positive and by reversing the electric motor 10, since counterrotation can be carried out, counterrotation of the fan 5 can be carried out easily, and it can also use as thrust reverse at the time of landing of an airplane.

[0036]Next, drawing 5 is a sectional view showing the fuel cell type propeller turbine (henceforth a propeller turbine) as the 2nd gestalt of operation of the fuel cell type turbine engine of this invention.

[0037]As shown in a figure, the propeller turbine 25 of this embodiment is made the same composition as what was shown with the 1st gestalt of operation, and comprises the fuel cell 10 which generates electricity according to the electrochemical reaction of hydrogen and oxygen similarly and the electric motor 33, the free power turbine 26, the compressor 27, and the propeller 28. The free power turbine 26 and the compressor 27 are connected by the axis 29, and he is trying to build the electric motor 3 into this axis 29.

[0038]While the fossil fuel 19 and the compressed air 17 are supplied and the electrochemical reaction of hydrogen and oxygen generates electricity inside like the 1st gestalt of operation, the steam of high temperature high pressure (600 \*\* - 1000 \*\*) is generated by the fuel cell 3. The electric motor 3 operates with the generated electrical and electric equipment, and the axis 29 is rotated and operates the compressor 27. After the steam of the high temperature high pressure generated with the fuel cell 3 makes the free power turbine 26 rotate as a steam turbine and rotates the axis 29, it is emitted to the open air as the exhaust gas 30.

[0039]While the compressor 27 operates by rotation of the axis 29, compressing the core air 31 which flows from the admission port of the compressor 27 and introducing into the fuel cell 10, to the front end side of the compressor 27. The propeller 28 is rotated with the gear device which the axis of rotation 32 is established the compressor 27 and in the shape of the same

axle, and was formed at the tip of this axis of rotation 32, and the flow of the core air 31 mentioned above is generated.

[0040]Rotation of the propeller 28 generates the outer flow 33, and makes the airplane which equipped the propeller turbine 25 generate impelling force.

[0041]a book -- an embodiment -- a propeller turbine (fuel cell type) -- 25 -- \*\*\*\* -- composition - - carrying out -- having -- \*\*\*\* -- since -- having mentioned above -- operation -- the -- one -- a gestalt -- it can set -- a turbo-fan engine -- one -- having mentioned above -- (-- one --) - (-- seven --) -- being the same -- a technical feature -- having -- \*\*\*\*\* .

[0042]Next, drawing 6 is a sectional view showing the fuel cell type turboshaft engine (henceforth a turboshaft engine) as the 3rd gestalt of operation of the fuel cell type turbine engine of this invention.

[0043]As shown in a figure, the turboshaft engine 35 of this embodiment, It has the same composition as what was shown with the 1st gestalt of operation, The driving force from the fuel cell 10 which generates electricity similarly and the electric motor 36, the free power turbine 37, and the free power turbine 37 to the upstream of the output shaft 40 transmitted to the rotor shaft 39 which formed the rotor 38 in the upper bed part by a bevel gear, and the free power turbine 37. It comprises the gas JIENE turbine 41 separated and arranged and the compressor 42 in the free power turbine 37. The gas JIENE turbine 41 and the compressor 42 are connected by the axis 43, and the electric motor 36 is further built into the axis 43.

[0044]The turboshaft engine 35 of this embodiment, While supplying the fuel cell 10 as the compressed air 17 which inhales the core air 44 which flows from the front, is compressed with the compressor 42, and is shown in drawing 2, With the electric power which supplied the fossil fuel 19 to the fuel cell 10, and was generated by electrochemical reaction, and the steam generated in the fuel lateral electrode 14 at the time of power generation. With the steam which operates the gas JIENE turbine 41, and operates the compressor 42, and is discharged from the gas JIENE turbine 41. Since the free power turbine 37 is furthermore operated and it was made to carry out the rotation drive of the rotor 38, it will have the same technical feature as (1) - (6) which the turbo-fan engine 1 in the 1st gestalt of operation mentioned above mentioned above.

[0045]Next, drawing 7 is a sectional view showing the fuel cell type auxiliary power unit (henceforth an auxiliary power unit) as the 4th gestalt of operation of the fuel cell type turbine engine of this invention.

[0046]As shown in a figure, the auxiliary power unit 45 of this embodiment is made the same composition as what was shown with the 1st gestalt of operation, and comprises the fuel cell 10 which generates electricity similarly and the electric motor 46, the free power turbine 47, the compressor 48, and the output shaft 49. The free power turbine 47 and the compressor 48 are connected by the axis 50. The electric motor 46 is built into the axis 50.



[0047]In the fuel cell 10, while the fossil fuel 19 and the core air 51 are supplied and power generation is performed by the electrochemical reaction of hydrogen and oxygen inside, the steam of high temperature high pressure (600 \*\* - 1000 \*\*) occurs. The electric motor 46 operates with the generated electrical and electric equipment, and the axis 50 is rotated. The high-temperature-high-pressure steam generated in the fuel lateral electrode 14 is emitted as exhaust gas 51', after making the free power turbine 47 rotate as a steam turbine and rotating the axis 50. The compressor 48 rotates by the drive of the axis 50, the core air 51 is compressed, and it is introduced into the fuel cell 10 with the fossil fuel 19.

[0048]Thus, in the auxiliary power unit 45 of this embodiment. While inhaling and compressing the flowing core air 51 from the front and supplying the fuel cell 10 as the compressed air 17, The electric power which supplied the fossil fuel 19 to the fuel cell 10, and was generated by the electrochemical reaction of oxygen in the compressed air 17 in the fuel cell 10, and hydrogen in the fossil fuel 19, And with the actuation load of the free power turbine 47 by the steam generated in the fuel lateral electrode 14 at the time of power generation, while operating the compressor 42, Since it was made to output driving force from the output shaft 49 connected at the tip of the compressor 48 in the shape of the same axle, it will have the same technical feature as (1) - (6) in the 1st gestalt of operation mentioned above which the turbo-fan engine 1 mentioned above.

[0049]Next, drawing 8 is a sectional view showing the fuel cell type industrial use / ship turbine engine as the 5th gestalt of operation of the fuel cell type turbine engine of this invention (henceforth a ship turbine engine).

[0050]As shown in a figure, the ship turbine engine 52 of this embodiment, While having the same composition as what was shown with the 1st gestalt of operation and generating electricity similarly, It consists of the axis 56 which connects the electric motor 53, the gas JIENE turbine 54, the compressor 55 and the compressor 55 which operate with the electric power generated with the fuel cell 10 which generates a steam at the time of power generation, and the fuel cell 10, and the gas JIENE turbine 54. The electric motor 53 is built into the axis 56.

[0051]to the slipstream side of the gas JIENE turbine 54. The steam which drove the gas JIENE turbine 54 is introduced, it is provided by the free power turbine 57 it was made to operate independently [ the gas JIENE turbine 54 ], and this free power turbine 57, He is trying to transmit the driving force generated with a steam to the propeller etc. of the back which carried out the graphic display abbreviation with the driving shaft 58 connected in the shape of the same axle behind the free power turbine 57.

[0052]In the fuel cell 10, while the compressed air 17 which compressed the core air 58 with the compressor 55 is supplied and the electrochemical reaction of hydrogen in the fossil fuel 19 and oxygen in the compressed air 17 generates electricity inside with the fossil fuel 19, the

steam of high temperature high pressure (600 \*\* - 1000 \*\*) occurs. With this generated electrical and electric equipment, the electric motor 53 operates and the axis 56 is rotated. On the other hand, the high-temperature-high-pressure steam generated with the fuel cell 10 makes the gas JIENE turbine 54 rotate as a steam turbine, rotates the compressor 55 by rotation of the axis 56, compresses the core air 59, and introduces it into the fuel cell 10.

[0053]The gas JIENE turbine 54 is made to rotate, and it is introduced into the free power turbine 57, and the driving shaft 58 is made to rotate, and after the steam with which energy remains makes the propeller etc. which were provided in the back end of the driving shaft 58 generate impelling force, it is emitted to the exterior as the exhaust gas 60.

[0054]Thus, the ship turbine engine 52 of this embodiment, While inhaling and compressing the flowing core air 59 from the front and supplying the fuel cell 10 as the compressed air 17, With the electric power which supplied the fossil fuel 19 to the fuel cell 10, and was generated by electrochemical reaction, and the steam generated in the fuel lateral electrode 14 at the time of power generation. With the steam which operates the gas JIENE turbine 54, and operates the compressor 55, and is discharged from the gas JIENE turbine 54, make the free power turbine 57 operate it and with the driving shaft 58. Since it was made to rotate the power plant formed in the back end of the driving shafts 58, such as a propeller, it will have the same technical feature as (1) - (7) in the 1st gestalt of operation mentioned above which the turbo-fan engine 1 mentioned above.

[0055]. Next, drawing 9 drives the turbo-fan engine (fuel cell type) 1, the propeller turbine 25, the turboshaft engine 35, the auxiliary power unit 45, and the ship turbine engine 52 which were mentioned above. the fuel cell 10 shown in drawing 2 – instead of – these turboengines - - driving – this invention – it is a sectional view of a fuel cell showing details as the 6th gestalt of operation.

[0056]The fuel lateral electrode 62 and the air lateral electrode 63 put the electrolyte content ceramics 64, and the fuel cell 61 of this embodiment is attached. The fuel lateral electrode 62 and the air lateral electrode 63 are connected with the electric motor 65 by the electric wiring 66.

[0057]He replaces with the fossil fuel 19 shown in drawing 2 as fuel, and is trying to supply the refined hydrogen 67 to the fuel lateral electrode 62 from a hydrogen cylinder etc. in the fuel cell 61 of this embodiment. He is trying to supply the compressed air 68 from compressor 7 grade to the air lateral electrode 63 like the fuel cell 10 shown in drawing 2.

[0058]In the fuel cell 61 constituted in this way, in the fuel lateral electrode 62, the supplied hydrogen 67 and the oxide ion 69 generated with the air lateral electrode 63 react, and the electron 70 and the steam 71 are generated. In the air lateral electrode 63, it generates with oxygen and the fuel lateral electrode 62 in the compressed air 68, The electron 70 transmitted to the air lateral electrode 63 is connected, the oxide ion 69 is generated, and as mentioned

above, this oxide ion 69 passes along the inside of the electrolyte content ceramics 65, is transmitted to the fuel lateral electrode 62, and as mentioned above, it generates the electron 70 and the steam 71 to the fuel lateral electrode 62.

[0059]On the other hand, the compressed air 68 whose oxygen content decreased by generation of the oxide ion 69 is emitted out of the fuel cell 61 as the exhaust gas 72.

[0060]The reaction formula by the fuel cell 61 of this embodiment is shown in several 1.

[0061]

[Equation 1]

燃料側電極での反応： $H_2 + O^{2-} \rightarrow H_2O + 2e^-$

空気側電極での反応： $\frac{1}{2}O_2 + 2e^- \rightarrow O^{2-}$

全体の反応： $H_2 + \frac{1}{2}O_2 \rightarrow H_2O$

[0062]In the fuel cell 61 of this embodiment, since it replaces with the fossil fuel 69 and he is trying to use hydrogen as fuel supplied to (1) fuel lateral electrode 62, refining of fuel becomes unnecessary and structure can be simplified.

[0063](2) Since he is trying to supply the compressed air 68 which compressed the supply air supplied to the air lateral electrode 63 in the compressor 7 grade, generation efficiency can be raised.

[0064]Next, drawing 10 is a sectional view showing the details of the fuel cell as the 7th gestalt of operation of this invention.

[0065]While the fuel lateral electrode 62 and the air lateral electrode 63 put the electrolyte content ceramics 64 and are attached like the fuel cell 61 shown in drawing 9, the fuel cell 73 of this embodiment, He is trying to supply the compressed air 68 from compressor 7 grade to the air lateral electrode 63 like the fuel cell 10 shown in drawing 2.

[0066]On the other hand, the reforming chamber 76 as a reaction chamber is formed in a supply side of the fossil fuel 74 of the fuel lateral electrode 62 via the porous bulkhead 75. The fossil fuel 69 is supplied to the fuel lateral electrode 62 of the fuel cell 73 of this embodiment constituted in this way through the reforming chamber 76 and the porous room`septum 75. In this case, a part of steam 71 produced with the fuel lateral electrode 63 with power generation in the fuel cell 73 passes the porous bulkhead 75, it goes into the reforming chamber 76 as a reaction chamber, reacts to the gaseous fossil fuel 74 supplied by fuel supply means in the reforming chamber 76, and generates the hydrogen 67 and carbon monoxide.

[0067]In [ the mixed gas 77 of this hydrogen and carbon monoxide passes the porous

bulkhead 75, is introduced into the fuel lateral electrode 62, and ] the fuel lateral electrode 62, As it reacts to the oxide ion 69 generated with the air lateral electrode 63 and the electron 70, the steam 71, and carbon dioxide were mentioned above, generate and a part of steam 71. While being introduced into the reforming chamber 76 and used for a reaction with the fossil fuel 74, it becomes the exhaust gas 78 mixed with carbon dioxide, and the fuel cell 73 is discharged, and the remaining steams 71 drive a turbine, as mentioned above.

[0068]On the other hand, the compressed air 68 supplied to the air lateral electrode 63, It generates in oxygen and the fuel lateral electrode 62 in the compressed air 68 with the air lateral electrode 63, The electron 70 transmitted to the air lateral electrode 63 is connected, the oxide ion 69 is generated, it passes along the electrolyte content ceramics 65 allocated between the fuel lateral electrode 62 and the air lateral electrode 63, and is transmitted to the fuel lateral electrode 62, and the electron 70 and the steam 71 are generated.

[0069]Air where whose oxygen component oxygen and the electron 70 in the air were connected in the air lateral electrode 63 at, the oxide ion 69 generated, and decreased, It is emitted from the fuel cell 79 as the exhaust gas 72, and a fuel cell type turbine engine as well as the exhaust gas 78 which the steam 71 and carbon dioxide mixed is driven.

[0070]Thus, in the fuel cell 73 of this embodiment. (1) By including the reforming chamber 76 in the fuel lateral electrode 62, as fuel of the fuel cell 73, while being able to use the fossil fuel 74, Since a reforming chamber which divides the fossil fuel 74 into the hydrogen 67 and carbon monoxide was provided in the fuel cell 73, structure can be simplified rather than a fuel cell which formed a reformer separately.

[0071](2) Since he is trying to supply the compressed air 68 which compressed a supply air supplied to the air lateral electrode 63 in compressor 7 grade, generation efficiency can be raised.

[0072]Next, drawing 11 is a sectional view showing details of a fuel cell as the 8th gestalt of operation of this invention.

[0073]Like the fuel cells 61 and 73 shown in drawing 9 and drawing 10, while the fuel lateral electrode 62 and the air lateral electrode 63 put the electrolyte content ceramics 64 and are attached, the fuel cell 79 of this embodiment, He is trying to supply the compressed air 68 from compressor 7 grade to the air lateral electrode 63 like the fuel cell 10 shown in drawing 2.

[0074]On the other hand, the reforming chamber 80 as a reaction chamber it was made to contact the fuel lateral electrode 62 completely is formed in fossil fuel 74 supply side of the fuel lateral electrode 62. Thus, if it provides all over the fuel lateral electrode 62 side of the fuel cell 79 and the fossil fuel 74 is supplied to the reforming chamber 80, The steam 71 produced in the fuel lateral electrode 62 by the reaction of the oxide ion 69 and the fossil fuel 74 goes into the reforming chamber 80, reacts to the introduced fossil fuel 74, and generates the hydrogen 67 and carbon monoxide. In the fuel lateral electrode 62, the mixed gas 77 of this hydrogen 67

and carbon monoxide that were generated is generated by the air lateral electrode 63, it passes the electrolyte content ceramics 64, reacts to the oxide ion 69 which reached the fuel lateral electrode 62, and generates the electron 70, the steam 71, and carbon dioxide.

[0075]The steam 71 which was not used for a reaction with the fossil fuel 74 serves as the exhaust gas 78 mixed with carbon dioxide generated with the fuel lateral electrode 62, is discharged from the fuel cell 79, and as mentioned above, it drives a turbine.

[0076]On the other hand, the compressed air 68 supplied to the air lateral electrode 63, It generates in oxygen and the fuel lateral electrode 62 in the compressed air 68 with the air lateral electrode 63, The electron 70 transmitted to the air lateral electrode 63 is connected, the oxide ion 69 is generated, it passes along inside of the electrolyte content ceramics 65 allocated between the fuel lateral electrode 62 and the air lateral electrode 63, and is transmitted to the fuel lateral electrode 62, and the electron 70 and the steam 71 are generated.

[0077]In the air lateral electrode 63, oxygen and the electron 70 in the air are connected and the oxide ion 69 generates, Air whose oxygen component decreased is emitted from the fuel cell 79 as the exhaust gas 72, and a fuel cell type turbine engine as well as the exhaust gas 88 which the steam 71 and carbon dioxide mixed is driven.

[0078]Thus, in the fuel cell 79 of this embodiment, since capacity which reacts the reforming chamber 80 is expandable while an effect of (1) in the fuel cell 73 of the 7th gestalt of operation shown in drawing 10 mentioned above and (2) and same effect are acquired, reforming efficiency of the fossil fuel 74 can be raised.

[0079]As mentioned above, as mentioned above, the fuel cells 61, 73, and 79 as the 6th gestalt of operation of this invention shown in drawing 9 - drawing 11 - the 8th gestalt, It can apply to all of the fuel cell type turbine engines 1, 25, 35, 45, and 52 as the 1st gestalt of operation of this invention - the 5th gestalt that show drawing 1, drawing 5 - drawing 8, and a technical feature of each fuel cell type turbine engine can be demonstrated.

[0080]

[Effect of the Invention]As explained above, the fuel cell type turbine engine of this invention, The fuel cell which generates electricity according to the electrochemical reaction of hydrogen in a fossil fuel or hydrogen, carbon monoxide, and oxygen in the air, With the turbine formed in the driving shaft generated by driving force by the motor which uses as a power supply electric power generated with the fuel cell, and makes a driving shaft generate driving force, and a motor, and the steam generated at the time of power generation of a fuel cell. The steam feeding means makes a turbine generate driving force and it was made to generate driving force also with the driving force of a turbine in addition to the driving force of a motor shall be formed.

[0081]Thereby, in the fuel cell type turbine engine of this invention, electrochemical reaction is

used, a combustion stroke disappears from chemical reaction combustion of a fossil fuel by considering it as the fuel cell which was made to generate electricity, there is no generating of nitrogen oxides, and the yield of carbon dioxide can also reduce the drive of (1) turbine engine.

[0082](2) moreover -- since a fuel cell is incorporable into the portion which installs the conventional burner -- a weight saving -- it can miniaturize.

[0083](3) By absorbing and exploiting in a turbine the energy of the steam generated with the fuel cell, it can combined-cycle-ize and generation efficiency can be raised as compared with power generation using chemical reaction combustion.

[0084](4) While being able to consider it as low fuel consumption since a turbine engine is driven with an electric motor, and a turbine engine can be operated in rating, the efficiency by part load can also be raised.

[0085](5) An electric motor can be used as an engine starter needed for a turbine engine.

[0086](6) -- further -- the change of an electric circuit -- a driving shaft -- positive, since counterrotation can be carried out, In the ship turbine engine which needs sternway, or the turbine engine for airplanes which needs to generate stopping force, by reversing an electric motor, counterrotation of a propeller or the fan can be carried out easily, and the purpose can also be attained.

[0087]The fuel cell type turbine engine of this invention shall form the compressor which generates the compressed air supplied to the air lateral electrode of the fuel cell which generates electricity according to electrochemical reaction to the driving shaft driven in a motor and a turbine.

[0088]By this in the fuel cell type turbine engine of this invention. While being able to raise generation efficiency by making air to a fuel cell to supply into compressed air, Since it drives in the turbine which operates with the steam which a compressor generates at the time of the motor which operates with the electric power generated with the fuel cell with sufficient generation efficiency, and power generation, engine efficiency can be raised.

[0089]In the fuel cell type turbine engine of this invention, it can make it possible to use a fossil fuel as it is as fuel which generates electricity, the necessity of providing separately the reaction chamber moreover separated into hydrogen and carbon monoxide as fuel which performs power generation from a fossil fuel can be abolished, and structure can also simplify more.

---

[Translation done.]

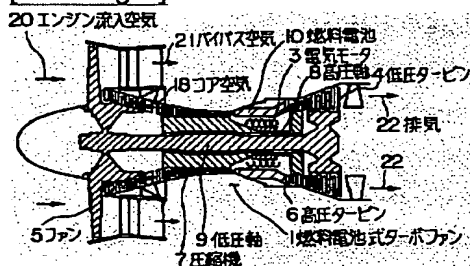
## \* NOTICES \*

JPO and INPIT are not responsible for any damages caused by the use of this translation.

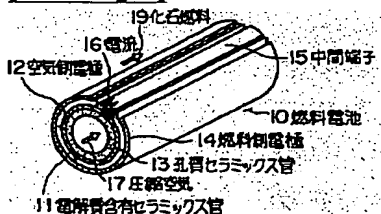
- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

## DRAWINGS

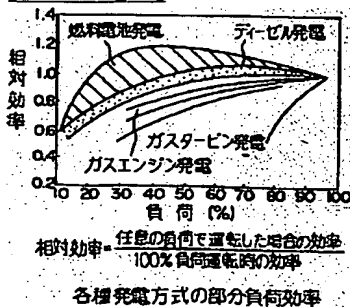
[Drawing 1]



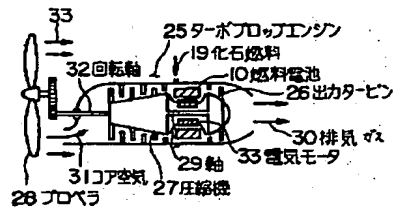
[Drawing 2]



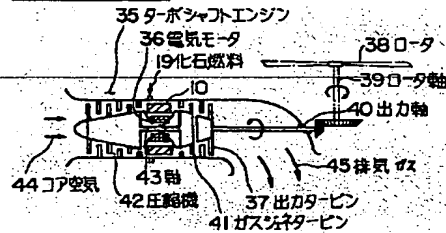
[Drawing 4]



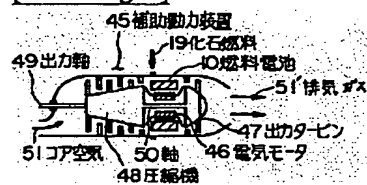
[Drawing 5]



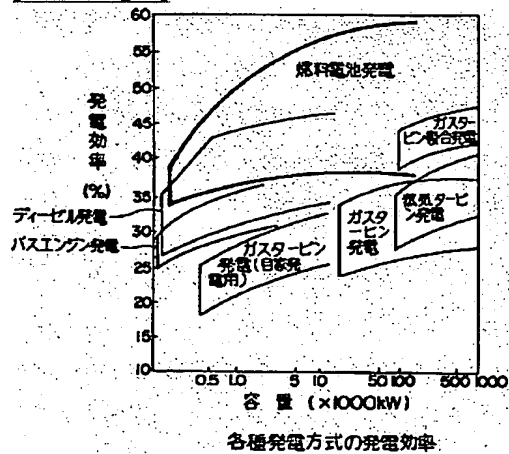
[Drawing 6]



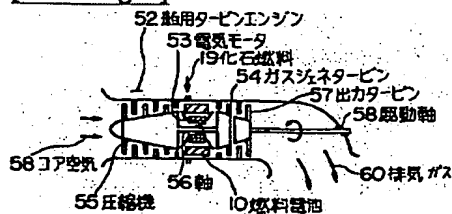
[Drawing 7]



[Drawing 3]

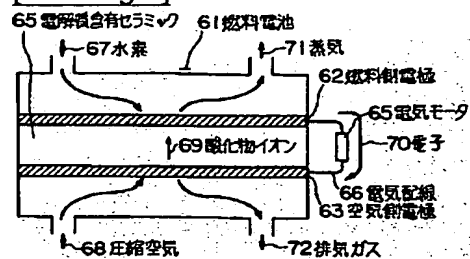


[Drawing 8]

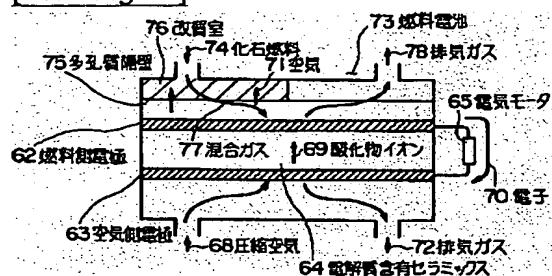




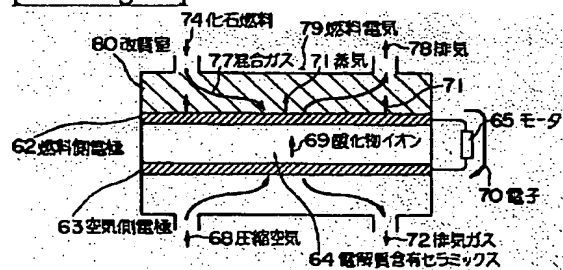
[Drawing 9]



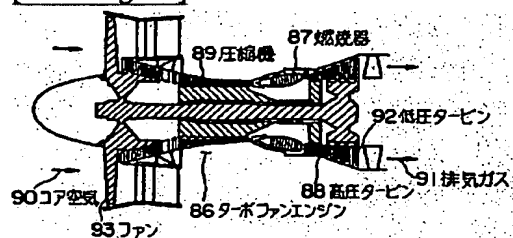
[Drawing 10]



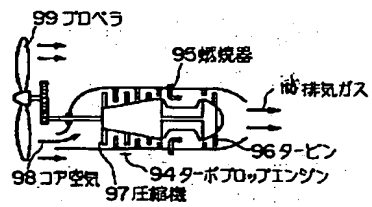
[Drawing 11]



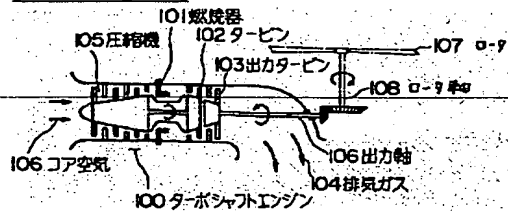
[Drawing 12]



[Drawing 13]



[Drawing 14]



[Translation done.]

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☒ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☒ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:**

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**